DOCUMENT RESUME

ED 125 608 95 IR 003 695

AUTHOR	Beard, Marian
TITLE	Computer Assisted Instruction: The Best of ERIC, 1973-May 1976.
INSTITUTION	Stanford Univ., Calif. ERIC Clearinghouse on Information Resources.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
PUB DATE	Aug 76
CONTRACT	NIE-C-74-0027
NOTE	42p.; For a related document see ED 076 025
AVAILABLE FROM	Box E, School of Education, Stanford University, Stanford, California 94305 ($2.25, Check made payable to "Box E" MUST accompany order)
EDRS PRICE	MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS	*Annotated Bibliographies; Case Studies; *Computer Assisted Instruction; Computer Oriented Programs; Computer Programs; Educational Innovation; Educational Research; *Educational Technology; Experimental Programs; Information Sources; Media Research; Programing; Teacher Education
IDENTIFIERS	PLATO; Programmed Logic for Automatic Teaching Operations; TICCIT

ABSTRACT

This bibliography contains annotations of reports, reviews, and other documents on computer-assisted instruction (CAI) derived from a search of the Educational Resources Information Center (ERIC) system. It covers 1973 to May 1976 and serves as an update to an earlier paper, "The Best of ERIC: Recent Trends in Computer Assisted Instruction" (ED 076 025). Section one covers major issues of interest, and section two presents specific applications and cases of CAI. PLATO and TICCIT, two interactive CAI programs, are the subjects of entries in section three. Research via CAI is covered in section four, and the last section covers descriptions of other CAI work such as applications in teacher training, development of author languages, and districtwide experience implementing CAI. (CH)

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ED125608

Computer Assisted Instruction: The Best of ERIC 1973-May 1976

Marian Beard

August 1976

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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Published by the ERIC Clearinghouse on Information Resources,
Stanford Center for Research and Development in Teaching,
School of Education, Stanford University, Stanford, California 94305

EDITOR'S NOTE

This bibliography contains annotations of reports, reviews, and other documents on computer-assisted instruction indexed and available through the ERIC (Educational Resources Information Center) system. This paper covers 1973-May 1976 and serves as an update to an earlier paper published by the ERIC Clearinghouse at Stanford, THE BEST OF ERIC: RECENT TRENDS IN COMPUTER-ASSISTED INSTRUCTION (ED 076 025) by Richard Clark (1973, 15pp.).

Documents with ED numbers listed in this publication may be ordered from ERIC according to the price chart at the conlusion of this paper.

Readers who know of reports on computer-assisted instruction that are not now indexed and available through ERIC are encouraged to submit them to the ERIC Clearinghouse on Information Resources. For complete information on submitting materials to ERIC, write, Director of Acquisitions, ERIC Clearinghouse on Information Resources, SCRDT, Stanford University, Stanford, California 94305.

Ms. Marian Beard, who chose and compiled the annotations and wrote the introduction for this paper, is with the Institute for Mathematical Studies in the Social Sciences at Stanford University.

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INTRODUCTION

The goal of this review is to present a reasonably brief, yet reasonably thorough, view of computer-assisted instruction (CAI) as reflected by documents entered into ERIC (Educational Resources Information Center) [illegible] 1973 through May 1976. Presumably, computers will eventually play a more important direct role in schools, at least throughout the United States, than do textbooks and other educational tools and technologies today. Such tools as audiovisual media, mechanical teaching devices, and self-instructional programmed texts have not yet been used for all they are worth. The range and depth of their applications and abilities to motivate and involve students have certainly not yet been exploited to the fullest.

However, the potential of CAI as an educational technology extends beyond these other tools and media, if only because it is inherently interactive. CAI consists of a dialogue between a student and a program, ranging from simple exchanges in rigid formats to natural language conversations carried out in almost "human" English. No other teaching tool or environment, with the obvious and essential exception of a one-to-one student-teacher interaction, could possibly provide the same richness of information, response analysis, individualized treatment, or hands-on practice as is possible in the best current CAI programs.

Still, CAI is very much in its youth. One topic not covered in this review is the development of hardware (notably small, powerful computers and relatively inexpensive display terminals) which will probably contribute much to the growth of CAI as an effective and affordable educational resource. Yet even if the physical computer systems themselves had reached their limits of compactness, versatility, and economy, their application in education would still be the subject of scientific investigation and comparative evaluation for many years. The reason is fairly simple: We do not yet know how people learn, so we cannot yet teach people as well as we would like.

At present, CAI comes in many flavors and combinations. Without attempting to systematically define the continuum of computer uses in instruction, simulation, computer-managed instruction, tutorial work, and so on, we might mention the most-often-used applications of CAI. Perhaps the most well-established is the drill-and-practice type of program, especially in elementary mathematics, which has been a sound success in school districts all over the country, and is now available in commercial curriculum packages. Another familiar use of CAI is in college-level classes (frequently, but not exclusively, in science or mathematics), where computer-based modules provide review, additional practice or "enrichment" work, and direct experience with simulated processes or methods in the subject area. Another application is at the level of the individual classroom (elementary and secondary), where the interested teacher plans and constructs "computer lessons" or games for his or her students. Yet another use is the extremely sophisticated, usually large, computer programs on which state-of-the-art research is based. Most of the other uses of CAI are adaptations of previously developed programs or applications of research results. Each of these areas, except the commercially available curricula, is represented in this review, although the emphases vary.

A note about the selection of abstracts from the vast supply listed in ERIC: An effort was made to include only those articles that are

up-to-date, those that seem to summarize accomplishments rather than report work in progress, and those that describe aspects of CAI of interest to a wide audience of readers.

Section One (CAI in General) covers major issues of interest, such as learner control, appropriate amounts and kinds of reinforcement, attitude change, evaluation of CAI, costs and other implementation factors. Articles appearing here were selected to provide an overall answer to the question "What is CAI, anyway?"

Section Two (Specific Applications and Cases) gives an idea of the range of programs that have been developed in the past few years. Interested readers should not expect to find programs that fit all the requirements of their current situations. The variety of CAI now in use, however, should at least stimulate thought and further developments. Articles were selected because they describe applications of CAI to real-life situations. They illustrate subject matter that lends itself to CAI and the range of ways CAI can be used in the "real world." Articles describing experimental projects, unmanageable implementations (in terms of cost or computer resources), or exotic subject areas are not included, since they seem to be less useful to a general audience than the numerous "working CAI" projects in operation around the country.

Section Three (PLATO and TICCIT) presents a fraction of the literature describing these two long-term, federally-supported efforts. These systems deserve a section of their own in this review largely because they were the objects of massive NSF funding aimed at demonstrating the effectiveness of CAI on a large scale. Their success is still being evaluated, but one outcome is clear: These two very different conceptions and implementations have not defined the "best" methods of CAI. Rather, their different achievements have helped to expand the necessary areas of investigation, as they have demonstrated the breadth of the possibilities. This section includes almost all the abstracts from PLATO and TICCIT currently available from ERIC. Interested readers probably should correspond directly with the listed authors for more extensive literature.

Section Four (Research via CAI) gives a slightly different view of the kinds of investigations being carried out. The projects and systems mentioned here all represent aspects of the in-depth research that CAI facilitates. Many projects deal with individualization and optimization of instruction (i,e., research in CAI itself), while others are concerned with research in particular subject areas, and use CAI as the medium in which experimentation is conducted. Some of these systems borrow from and/or contribute to the field of artificial intelligence, an area that will probably become more important to the development not only of CAI but of other computer applications as well (e.g., medical diagnosis). Criteria for selection in this section included the expected impact of the reported research on the development of CAI and the degree to which the research illustrates the variety of experimentation and evaluation being done. This section is similar to Section Two in that it describes current activity in the field of CAI. The difference is that the applications in Section Two are typically cost-effective, reliable programs in daily use; the research work in Section Four is much more sophisticated and powerful, but much more expensive and developmental. Within ten years or so, projects described in this section will probably appear in the "Applications" section of a review like this one.

Finally, Section Five covers descriptions of other CAI work such as

applications in teacher training, development of author languages to make CAI more accessible to non-programmers, and district-wide experience with the implementation of CAI.

Some areas are not covered explicitly in this review. Hardware developments were mentioned above. Other topics excluded from the paper are computer-generated testing, computer simulations, computer-managed instruction (CMI), and research that demonstrates the effectiveness of CAI as compared to traditional teaching methods. Testing, simulation, and CMI are important instructional uses of computers, and their absence here is almost entirely due to space limitations and the wealth of information on more "pure" CAI. As to specific demonstrations of usefulness, it seems clear at this time that CAI has vast potential as an effective teaching and research tool, and the case studies serve mainly to reinforce this fact. The question is no longer, "CAN computers be used to deliver instruction?" but rather "HOW should computer programs be designed to provide the most effective instruction for each student?" A variety of answers to this question can be expected in the next edition of this review.

SECTION 1: CAI IN GENERAL

Anastasio, Ernest J., and Judith S. Morgan. FACTORS INHIBITING THE USE OF COMPUTERS IN INSTRUCTION. Bethesda, Maryland: Interuniversity Communications Council, 1972. 130pp. ED 069 219.

> In the direct application of compters to the instructional process, obstacles still exist between promise and fulfillment. This study seeks to identify those obstacles and to suggest means for overcoming them. The Delphi Technique was used to obtain and analyze the judgment of educational practitioners, theoreticians, hardware and software specialists, and evaluators on (a) major impediments to wider use of computers in instruction, and (b) actions that might increase acceptance and use of computer-based instructional materials.

Baker, Justine C. THE COMPUTER IN THE SCHOOL. FASTBACK NO. 58. Bloomington, Indiana: Phi Delta Kappa Educational Foundation, 1975. 42pp. Available from Phi Delta Kappa, Eighth and Union, Box 789, Bloomington, Indiana 47401 ($.50). ED 107 222.

> This document describes the history and development of computers generally and of computer-assisted instruction (CAI) specifically. Included is information on several CAI systems currently in operation including (1) Programed Logic for Automatic Teaching Operations (PLATO), (2) Time Shared Interactive Computer-Controlled Information Television (TICCIT), (3) the LOGO programing language for mathematics instruction, and (4) Program for Learning in Accordance with Need, (PLAN). Comments are also provided on current capabilities and future directions of both administrative data processing and CAI in American schools.

Blum, Ronald. CONDUIT: AN EXPERIMENT IN EDUCATIONAL COMPUTER USAGE AND PROGRAM EXCHANGE. Durham, North Carolina: Duke University, CONDUIT, 1972. 37pp. ED 066 916.

CONDUIT is a consortium of five regional computer networks, and is designed to (1) establish a center for information collection and dissemination concerning computer-related curriculum materials; and (2) to identify and evaluate factors governing ease of movement of computer-related curriculum materials from one school to another. The information clearinghouse goal of CONDUIT will rely on a data base built from Entry Documentation Forms for each curriculum item. Testing will begin with workshops in seven different disciplines conducted by the regional networks, but the major testing will be conducted independently by the Human Resources Research Organization.

Bork, Alfred. GEORGE LEONARD'S VIEW OF THE COMPUTER IN EDUCATION. Irvine, California: University of California, Irvine, Physics Computer Development Project, 1974. 9pp. ED 102 946.

Relatively few individuals have attempted to view the future of computers in education, and those who have done so often tend to focus too much upon present capabilities rather than thinking about the changes that new technology will introduce. George Leonard's book "Education and Ecstacy" provides an interesting picture of what schools in the year 2001 will be like. He suggests that through extended computer technology students will be motivated to learn all basic information, including calculus, between the ages of three and ten. Children are depicted as linked directly to the computer through headphones that pick up the child's brain signals and indicate to the computer whether the child is comprehending the lesson. The implications of Leonard's book are worthy of serious consideration despite the resistance that computer-assisted instruction may face.

Bukoski, William J., and Arthur L. Korotkin. COMPUTING ACTIVITIES IN SECONDARY EDUCATION. FINAL REPORT. Washington, D.C.: Institutes for Research in the Behavioral Sciences, 1975. 177pp. ED 112 935.

As a followup to a 1969 study, called Project CASE, a survey was initiated to determine to what extent computers are used in secondary public schools, and to discern to what extent computers affect the quality of education. Some 5,580 randomly selected schools were questioned. For the period 1970-1975, some major findings were: (1) the use of computers is expanding; (2) schools tend to use computers for both instruction and administration; (3) computer-assisted instruction is being used more but it continues to be employed predominantly in the instruction of computer science and mathematics; (4) with regard to administration, the computer is most frequently used for student accounting and resource management; and (5) BASIC has become the predominant language.

Bunderson, C. Victor. THE TICCIT PROJECT: DESIGN STRATEGY FOR EDUCATIONAL INNOVATION. ICUE TECHNICAL REPORT NO. 4. Provo, Utah: Brigham Young University, Institute for Computer Uses in Education, 1973. 32pp. ED 096 996.

The educational contributions and courseware design strategies

which have evolved at Brigham Young University in the course of developing TICCIT (Time-sharing Interactive Computer-Controlled Information Television) are given. The Mitre Corporation and the University of Texas CAI Laboratory also cooperated in this project, which is an advanced version of computer-assisted instruction. Specified in this report are some parameters of the TICCIT courseware system and the design strategy, learner control, and mastery techniques used by the developers. The role of students, teachers, and their educators are outlined in the context of the instructional needs in mathematics and English at community colleges.

Fitzgerald, William F. A MATHEMATICAL MODEL FOR PROJECT PLANNING AND COST ANALYSIS IN COMPUTER ASSISTED INSTRUCTION. Ann Arbor, Michigan: University of Michigan, School of Dentistry. Paper presented at the Association for the Development of Computer-Based Instructional Systems Annual Meeting, Cap Rouge, Quebec, August 7-9, 1973. 13pp. ED 083 821.

Computer-assisted instruction (CAI) has become sufficiently widespread to require attention to the relationships between its costs, administration, and benefits. Despite difficulties in instituting them, quantifiable cost-effectiveness analyses offer several advantages. They allow educators to specify with precision anticipated instructional loads, to conduct valid long-range planning, to set criteria and goals against which instructional delivery can be measured, and to develop common bases for comparison of instructional alternatives.

Fletcher, J. D. COMPUTER APPLICATIONS IN EDUCATION AND TRAINING: STATUS AND TRENDS. San Diego, California: Navy Personnel Research and Development Center, 1975. 63pp. ED 108 681.

This report provides information on new computer-based training developments that may have implications for the Navy. Although projects in the military services are emphasized, major developments in the civilian sector also are reviewed. The range of activities emphasizes the use of computers for teaching and includes a wide variety of computer aids to instruction. It is organized under five major topic headings: (1) military activities, (2) civilian activities, (3) systems developments, (4) current issues in instructional design, and (5) state-of-the-art and Navy training needs.

Hall, Keith A. CURRICULAR AND COMPUTER SYSTEM COMPATIBILITY OF CAI PROGRAMS FOR MULTI-UNIVERSITY USE. University Park, Pennsylvania: Pennsylvania State University, Computer-Assisted Instruction Lab, 1973. Paper presented at the EDUCOM Fall Conference, Princeton, New Jersey, October 1973. 22pp. Available from: "Facts and Futures: What's Happening Now in Computing for Higher Education," Proceedings of the Fall 1973 EDUCOM Conferences, EDUCOM, P. O. Box 364, Princeton, New Jersey, 08540 ($9.00). ED 093 322.

A brief introduction to developmental efforts in computer-assisted instruction (CAI) at Pennsylvania State University is followed by a description of a program of mobile CAI facilities inaugurated in 1970 as part of the inservice continuing education program for teachers. The paper includes brief descriptions of the graduate level courses included in

the system, the actual physical facilities used for the mobile project, and the implementation schedule. Finally there is a short section on curricular compatibility and another on systems compatibility or convertibility.

Hickey, Albert E. RESEARCH GUIDELINES FOR COMPUTER-ASSISTED INSTRUCTION. 1974. 77pp. Available from: Albert E. Hickey Associates, 42 Pleasant Street, Newburyport, Massachusetts 01950 ($10.00).

Prepared for the Defense Advanced Research Projects Agency (ARPA), this report contains 59 recommendations for research and development in support of computer-assisted instruction (CAI). The guidelines were derived from interviews with 14 leading education researchers. They cover the following learning and instruction variables: (1) learning outcomes; (2) subject-matter hierarchies; (3) instructional strategies and decision rules; (4) individual difference variables, including aptitude; (5) locus of control; (6) the student/computer interface; (7) response analysis; and (8) feedback to the student.

Littrell, R. F. THE ECONOMICS OF COMPUTER AIDED INSTRUCTION. Paper presented at the Association for Education Data Systems Annual Convention, New Orleans, Louisiana, April 16-19, 1973. 20pp. ED 087 418.

Computer-assisted instruction (CAI) has not been cost-effective, despite its instructional effectiveness. This financial failure can be attributed to many factors, including: oversell of CAI capabilities, poorly authored content, expensive and unreliable hardware, an educational bureaucracy resistant to innovation, and the decentralized nature of American education which works against the widespread implementation of CAI systems. Educators can achieve a high level of awareness of CAI's complexity, and thereby promote its success if they assess needs and establish priorities for CAI use; commit resources to CAI on a long-term basis; release faculty for program planning and development; review the impact of CAI on other aspects of the school system; provide the necessary facilities to house the system; offer school-wide orientation programs; and use a team approach in implementing CAI.

MINUTES AND PROCEEDINGS OF THE SEMI-ANNUAL MEETING OF THE ASSOCIATION FOR DEVELOPMENT OF INSTRUCTIONAL SYSTEMS (ADCIS). UNIVERSITY OF MICHIGAN, AUGUST 7-9, 1973. 41pp. ED 086 202.

Abstracts of 23 papers given at the conference deal with the educational uses of computers, including: (1) information networking, (2) computer-managed test item banks, (3) learner controlled instruction and courseware, (4) computer-assisted instruction (CAI) systems such as Courseuriter III and PLATO, (5) CAI programs in different content areas, (6) CAI authoring, (7) cost-effectiveness and cost analysis of CAI, (8) computer graphics, and (9) minicomputers.

PROCEEDINGS OF THE 1975 CONFERENCE ON COMPUTERS IN THE UNDERGRADUATE CURRICULA, CCUC/6, TEXAS CHRISTIAN UNIVERSITY, FORT WORTH, TEXAS, JUNE 16-18, 1975. 1975. 305pp. Available from: Ted Sjoerdsma, Treasurer, CCUC, 124B Lindquist Center for Measurement, Iowa City, Iowa 52242 ($10.00, Checks payable to the University of Iowa).

With computer science specifically excluded as an area of interest, the papers reproduced here fall under the following headings: humanities, business, physics, computerized test construction, mathematics science, computer-managed instruction and computer-assisted instruction, and chemistry. The papers report on specific materials, problems, programs, and measures of success or accomplishment.

Sullivan, Daniel John. COMPUTER ASSISTED INSTRUCTION FOR MANAGEMENT AND BUSINESS STUDY: A LOOK TO THE FUTURE. Master's Thesis. George Washington University, 1975. 125pp. ED 114 093.

Business and management study programs are making increasing but still limited use of computer-assisted instruction (CAI) as an instructional tool. The cost of course development and design for business and management instruction is high, but declining hardware costs and increasing use lower per student hour costs. CAI is now used primarily for drill and practice in mathematics, word usage, and technical skills. Only recently has it been used in complex situations involving education and business theory. A survey of schools of business administration and management reveal that such programs now use CAI for about 5 percent of instruction. They are expected to increase their use in the next ten years to about 20 percent.

Taylor, Sandra, and others. THE EFFECTIVENESS OF CAI. Paper presented at the Annual Convention of the Association for Educational Data Systems, New York, May 1974. 26pp. ED 092 074.

This paper reviews the empirical research that has been done with computer-assisted instruction (CAI) in order to evaluate its effectiveness. CAI is divided into four basic modes: drill and practice, problem solving, tutorial, and simulation. Each mode is defined, and relevant research is discussed. Briefly, the conclusions were that CAI can be an effective instructional tool, that students generally learn more rapidly with CAI than with traditional methods, that CAI is more effective for low ability students than for middle and high ability students, and that both students and teachers are highly enthusiastic towards CAI as a means of instruction.

USE OF THE COMPUTER IN TEACHING AND LEARNING. Geneva, Switzerland: International Federation for Information Processing, 1974. 25pp. Available from: AFIPS Headquarters, 210 Summit Avenue, Montvale, New Jersey 07645 ($1.50).

This booklet was written to answer some basic questions about the use of the computer in education. Benefits of using computers to improve instruction, to provide learner control, and to develop a computer-literate society are discussed along with the potential the computer provides for cost saving in

alternative learning environments. Several approaches to the development of instructional material are suggested, followed by approaches which might be used to facilitate acceptance of computers. Key personnel roles in the use of the computer in education are outlined. A list of important considerations in the acquisition process for a computer are given, and the booklet concludes with a comment on the prospects for international cooperation in computer-based education systems.

Visich, Marian, Jr., and Ludwig Braun. THE USE OF COMPUTER SIMULATIONS IN HIGH SCHOOL CURRICULA. Stony Brook, New York: State University of New York, Huntington Computer Project, 1974. 36pp. ED 089 740.

The Huntington Computer Project has developed 17 simulation games which can be used for instructional purposes in high schools. These games were designed to run on digital computers and to deal with biology, physics, or social studies. The Digital Equipment Corporation disseminated teacher manuals, resource manuals, and student manuals to over 600 teachers and 25,000 students in 400 secondary schools during the 1972-73 school year. Evalution of the games led to the conclusion that they made a significant contribution to learning. This was particularly true in situations where students were denied direct experience with the phenomena being studied because of students' inexperience with experimental techniques, the lack of laboratory equipment or time, difficulty or danger in obtaining adequate examples, and the impossibility of controlling extraneous variables in real life.

Zender, Bryce F., ed. COMPUTERS AND EDUCATION IN THE SOVIET UNION. Englewood Cliffs, New Jersey: Educational Technology Publications, 1975. 145pp. Adapted from "The Application of the Computer in Soviet Education," edited by A. I. Berg. Available from: Educational Technology Publications, 140 Sylvan Avenue, Englewood Cliffs, New Jersey ($12.95).

Recent decades in the Soviet Union have witnessed a prolific growth of technology. The school system has been under pressure to become more systematic and to supply more qualified candidates to meet the demand of industry. Computer technology has been introduced in order to facilitate more detailed attention to educational objectives. Individualized programed instruction has been developed, and the system is designed to provide constant and immediate feedback to the student. The recent emphases of the development program have been: (1) the use of electronic computers for controlling the instructional process; (2) analysis of methods and algorithms for optimal instruction; (3) means of input and output for the computer during instruction; (4) construction of an adaptive training system; and (5) the use of computers to administer and organize the functioning of all levels of education.

Zinn, Karl L., ed., and others. COMPUTERS IN THE INSTRUCTIONAL PROCESS: REPORT OF AN INTERNATIONAL SCHOOL. Ann Arbor, Michigan: University of Michigan, Center for Research on Learning and Teaching, 1974. 650pp. Available from: Project EXTEND Exchange Library, University of Michigan (CRLT), 109 East Madison Street, Ann Arbor, Michigan 48104 ($8.00,

prepaid).

A conference attended by 40 "students" and 20 "teachers" was held to explore the state of the art in computer assisted instruction. The school was held in a remote Italian resort, but direct connections with computers in Italy and the United States provided opportunities for demonstrations of existing CAI systems. Papers fell into three broad categories. The first dealt with issues of CAI use in different educational contexts and disciplinary areas. The second group considered technical issues in the development, use, and evaluation of CAI. Included were papers on instructional software, learner controlled CAI, mathematical models of learning and performance, and the use of CAI for dispersed populations. The final group of papers described use of CAI at five institutions including Coast Community College District in California, Bari University in Italy, Stanford University, University of California at Irvine, and the University of Michigan.

Zinn, Karl L. FREE AND INEXPENSIVE MATERIALS ON COMPUTING IN TEACHING AND LEARNING ACTIVITIES. Ann Arbor, Michigan: University of Michigan, Center for Research on Learning and Teaching, 1974. 12pp. Available from: University of Michgain CRLT EXTEND Exchange Library, 109 East Madison Street, Ann Arbor, Michigan 48104 (free for single copies, $1.00 for eight copies or more).

This document is intended for individuals and institutions wishing to establish inexpensively a library of reference materials and periodicals on the use of computing in teaching and learning activities. Three sections are included: (1) periodicals avialable free or by subscription of $8.00 or less per year, (2) reference materials available for $10.00 or less, and (3) summaries of important projects in the field of instructional uses of computing in colleges and universities.

SECTION 2: SPECIFIC APPLICATIONS AND CASES

Bell, Frederick H. COMPUTER-RELATED LABORATORIES: AN INTER-DISCIPLINARY APPROACH TO LEARNING. Paper presented at the Association for the Development of Computer-Based Instructional Systems Summer Conference, Portland, Maine, August 4-7, 1975. 7pp. ED 111 426.

The computer-centered, interdisciplinary learning environment called Soloworks at the University of Pittsburgh is described and placed in the perspective of continuing curriculum change. The organization of the hardware into computer lab, dynamics lab, synthesis lab, modeling/simulation lab and logical design lab is explained. Teaching/learning innovations growing from the project are summarized; steps toward developing a secondary school curriculum are discussed. The project and related developments are said to make possible and practical a truly interdisciplinary and revolutionary approach to formal education.

Bork, Alfred. CURRENT STATUS OF THE PHYSICS COMPUTER DEVELOPMENT PROJECT. Irvine, California: University of California at Irvine,

Physics Computer Development Project, 1975. 23pp. ED 107 201.

With support from the National Science Foundation and the University of California, the Physics Computer Development Project have produced computer based material in a variety of modes. The project has four major objectives: to explore and produce examples of the effective use of graphics in computer-based teaching materials; to explore authoring modes; to introduce dialogs and other standard computer approaches into standard undergraduate environments; and to seek a compatible software strategy. Future projects include an organized Research Unit in Educational Technology and a single time-sharing computer for science teaching on all eight undergraduate campuses of the University of California.

Castleberry, Sam J., and others. THE IMPACT OF COMPUTERS ON UNDERGRADUATE CHEMICAL EDUCATION. Austin, Texas: University of Texas-Austin, Project C-BE, 1973. 19pp. ED 116 615.

Attempting to define the optimal use of educational resources for large numbers of students, a research group at the University of Texas at Austin has adopted a systems approach to curriculum development consisting of the following components: content, teacher, student, machine, and media. The first step is to define the objectives and tasks of the course in terms of related sets of behavioral objectives. Then, using information about teaching style, learning style, and available resources, a complete multimedia course can be designed that is tailored to each student. In one chemistry course, the technique was used to generate remedial modules to assist the student having difficulties with exam questions. Results indicate that computer-based techniques relieve the burden on the instructor, and they have a positive effect on student achievement and attitudes.

Demb, Ada Barbara. INSTRUCTIONAL USES OF COMPUTERS IN HIGHER EDUCATION: A SURVEY OF HIGHER EDUCATION IN MASSACHUSETTS. Cambridge, Massachusetts: Harvard University, 1974. 14pp. Paper presented at the EDUCOM Fall Conference, Toronto, Ontario, October 16-18, 1974. Available from Proceedings of the EDUCOM Fall Conference, EDUCOM, Rosedale Road, P. O. Box 364, Princeton, New Jersey 08540 (Estimated price, $6.00 for member institutions, $12.00 for others). ED 097 028.

A survey of computer use was conducted in 1974 in a small, nonrandom sample of Massachusetts colleges and universities. Allowing for inflation, but adjusting for the increase in computer power per dollar, it is clear that significantly more compute power is being devoted to instruction--both "with" and "about" the computer. The percentage of computer-using courses teaching "with" the computer is estimated to be about 70 to 75 percent of the total number of courses using computers. In particular physical sciences, social sciences, business, and mathematics have increased their computer use. The bulk of the application is in drill and practice, problem-solving, games, and simulations. By contrast, there are very few instances of tutorial or inquiry and retrieval uses.

Edgar, S. Michael. TEACHING STATISTICS, WHILE SIMULTANEOUSLY SAVING TIME, CHALK, ETC... Arlington, Texas: University of Texas at Arlington, Department of Business Administration, 1973. 9pp. Paper presented at the Conference on Computers in the Undergraduate Curricula, Claremont, California, June 18-20, 1973. ED 079 993.

The interactive computer terminal provides an opportunity to teach statistics innovatively. A computer-assisted instructional (CAI) program helps students by taking over the burden of computation. The instructor introduces a theoretical topic, describes its use, works examples, and has the students work a problem, doing the computation manually. Additional problems are then worked on the computer. The computer programs are written in conversational style to facilitate clear understanding. The program: (1) provides an introduction on methodology; (2) asks for data and shows how to enter them; (3) checks data accuracy and conducts calculations; and (4) gives results. Students who use the CAI program save time, achieve better overall understanding of statistics, and learn to deal with statistical material from other areas. Their manual computational skills, however, are not well developed.

Fielding, Gordon J., and Kennard W. Rumage, eds. COMPUTERIZED INSTRUCTION IN UNDERGRADUAGE GEOGRAPHY. Washington, D.C.: Association of American Geographers, 1972. 83pp. Available from Association of American Geographers, Commission on College Geography, Washington, D.C. 20009.

Different approaches to using computer-assisted instruction (CAI) in teaching geography are presented in this collection of papers. The first paper overviews the use of computers in undergraduate instruction. Next is a paper on a program at the University of Iowa which was designed to introduce students to some of the basic principles associated with spatial competition in location theory through sequentially ordered games. Following this paper is a presentation of a unit developed at the University of Minnesota which reviews heat and moisture balances and then applies these principles to man-environment interaction in East Africa. A third CAI program, from the State University of New York, examines aspects of land use decision through a gaming situation. A program designed primarily to develop the concept of relative locational advantage with respect to port growth, and to explore the structure of models and their application in problem solving, is presented next. The final CAI program is an exercise that explores concepts of distance and direction in geography. Three abstracts of additional geography-related CAI units are also included.

Golub, Lester S. A COMPUTER ASSISTED LITERACY DEVELOPMENT PROGRAM FOR CAREER ORIENTED YOUTHS AND ADULTS, AGES 14-24. FINAL REPORT. University Park, Pennsylvania: Pennsylvania State University, Computer-Assisted Instruction Lab, 1974. 66pp. ED 088 094.

The purpose of the project was to develop and validate a computer-assisted literacy development (LITE) program for career oriented youth, ages 14-24. The end product consists of adult diagnostic reading level tests, an occupational

interest inventory, and instruction in literacy and occupational information. The summative evaluation of the program showed that students participating in the LITE program made considerable gains in their literacy development and outstanding gains in their knowledge of career information. The attitude of students in the computer-assisted instruction mode of the program was significantly better than the attitude of students taking a programed text version of the program.

Hickok, Treacy A. COMPUTER EDUCATION FOR DEAF YOUNGSTERS: A MUTUAL EFFORT BY THE UNIVERSITY OF CALIFORNIA AND THE CALIFORNIA SCHOOL FOR THE DEAF IN BERKELEY. Berkeley, California: University of California, Berkeley, 1975. 45pp. Paper presented at the Association for the Development of Computer-Based Instruction Systems Summer Meeting, Portland, Maine, August 4-7, 1975. ED 111 439.

The California School for the Deaf (CSD) conducted a study to familiarize students and faculty with available programs at Lawrence Hall of Science and to see if the instruction and teaching philosophy was adequate for students with impaired hearing. The pilot student was positive, so objectives were formed to adapt current computer programs. Objectives included: (1) improvement of teacher attitude and ability concerning the computer; (2) improvement of student attitude and ability through training, and (3) an evaluation of the results of the year's project. The program was determined a success since there was a significant increase in the use of the computer by students and faculty at CSD.

Hofstetter, Fred T. COMPUTER APPLICATIONS TO MUSIC AT THE OHIO STATE UNIVERSITY: SUMMER, 1971 THROUGH WINTER, 1973. Columbus, Ohio: Ohio State University, School of Music, 1973. 12pp. Paper presented at the International Conference on Computers in the Humanities, Minneapolis, Minnesota, July 22, 1973. ED 082 511.

An analytic, statistical, synthetic, bibliographic, instructional, and automated music printing system is available at the Ohio State University. The computer analysis of music is described here, along with a list of programs available for computer-assisted musical analysis. Statistical research in music education and the development of a geneal purpose bibliographic system are considered.

Hultberg, W. Earle, and Mary Lou Hultberg. CAI IN MUSIC THEORY: PARADIGMS: POTENTIAL: PROBLEMS. Potsdam, New York: State University of New York, College at Potsdam, Crane School of Music, 1973. 4pp. Paper presented at the Conference on Computers in the Undergraduate Curricula, Claremont, California, June 18-20, 1973. ED 081 223.

Computer-assisted instructional programs have been developed at the State University College at Potsdam, New York, to teach basic concepts of music theory. The Computer-based Learning Experiences in Music Fundamentals (CLEF) project has spawned computer-assisted instruction (CAI) programs which use an IBM 360/30 configuration with 2741 terminals and the Coursewriter, BASIC, and APL languages. CLEF is intended for students at all levels of proficiency and provides an opportunity for flexible, self-directed study. To maximize CAI contributions,

it will be necessary to overcome the assumptions that CAI must be programed instruction (which, additionally, is "friendly" to students), and that the computer is going to replace the teacher.

Lower, Stephen K. CHEMEX: UNDERSTANDING AND SOLVING PROBLEMS IN CHEMISTRY. A COMPUTER-ASSISTED INSTRUCTION PROGRAM FOR GENERAL CHEMISTRY. Burnaby, British Columbia: Simon Fraser University, Department of Chemistry, 1973. 17pp. ED 081 202.

A brief overview of CHEMEX--a problem-solving, tutorial style computer-assisted instructional course--is provided, and sample programs are offered. In CHEMEX, students receive problems in advance and attempt to solve them before moving through the computer program, which assists them in overcoming difficulties and serves as a review mechanism.

Manwell, Tom. RESEARCH AND DEVELOPMENT FOR INTERACTIVE TEACHING OF RUSSIAN. FINAL REPORT. Cambridge, Massachusetts: Harvard University, Computer Aided Instruction Laboratory, 1973. 14pp. ED 082 473.

A computer-assisted instructional system for teaching Russian to college students is described. It was operational at Harvard University until September 1971 and then transferred to the State University of New York at Stony Brook. Treatment of second language acquisition, a critique of previous work in the field, and some remarks on CAI language teaching are followed by a discussion of the present system. The course is non-linear and individualized, allowing students to choose their own learning paths. Although the course stresses the Russian morphological system, the construction of the computer program is applicable to other languages and language teaching specialties.

Osgood, Gilbert W., and others. COMPUTERS IN THE TRAINING OF EXPERIMENTAL INQUIRY IN PSYCHOLOGY. Paper presented at the Conference on Computers in the Undergraduate Curricula, Claremont, California, June 18-20, 1973. 7pp. ED 082 480.

A program called Experiment Writer (EW) was designed to enable students to use the computer to sample a range of experimentation situations. EW was used by 20 students in an Advanced Experimental Psychology course. Students performed two teacher-designed experiments to familiarize themselves with variability and the logical relation of experimental design to psychological questions. They next ran each other as subjects on a teacher-designed experiment and devised an experiment of their own dealing with information and reaction time. The third phase of the course taught them how to use EW, thus giving them full control over the computer. Following this, they designed an experiment creating files and block definitions. Evaluation indicated that EW successfully introduced students to experimental inquiry and showed that student reaction was favorable.

Roman, Richard Allan, and Nicholas C. Laudato. COMPUTER ASSISTED INSTRUCTION IN WORD PROBLEMS: RATIONALE AND DESIGN. Pittsburgh,

Pennsylvania: University of Pittsburgh, Learning Research and Development Center, 1974. 46pp. ED 101 688.

A Word Problem Program was set up to teach elementary school students how to solve arithmetic word problems and to teach some problem solving skills applicable to nonword problems. All instruction is accomplished through a computer program. Goals of the program are described along with three basic instructional decisions and the reasons for them. The instructional design is detailed, along with samples of student interaction.

Rubin, Martin L., and others. EVALUATION OF THE EXPERIMENTAL CAI NETWORK (1973-1975) OF THE LISTER HILL NATIONAL CENTER FOR BIOMEDICAL COMMUNICATIONS, NATIONAL LIBRARY OF MEDICINE. FINAL REPORT. NO. ED-75-1. Alexandria, Virginia: Human Resources Research Organization, 1975. 85pp. ED 115 225.

An evaluation was made of the biomedical Computer Assisted Instruction Network Experiment, established by the National Library of Medicine in 1973 to test the feasibility of sharing CAI learning materials through a national computer network. The evaluation was designed to assist decision makers in planning a future mechanism for distributing biomedical CAI. The study focused on the institutions (95 as of October 1974) and people who use the network and the contractors who supplied the CAI library. Data sources included case studies, user reports, and interviews with hospital and medical school administrtors, faculty, librarians, computer laboratory staff, and students. Network usage by program type, by user institution, and by class of user were analyzed. Also analyzed were the impact of the network on curricula, faculty, students, libraries, and media centers, as well as the cost/benefits. The report includes a roster of the participants in the network experiment.

Spencer, Judson, and John P. Gobetti. COMPUTER AIDED INSTRUCTION AND PROBLEM SOLVING IN THE TEACHING OF ORAL DIAGNOSIS. Ann Arbor, Michigan: University of Michigan, School of Dentistry, 1974. 10pp. Paper presented at the American Educational Research Association Meeting, Chicago, Illinois, April 15-19, 1974. ED 089 677.

A computer-assisted instructional (CAI) program is being used at the University of Michigan School of Dentistry to aid in the teaching of oral diagnosis. The program is designed to simulate a real life situation--i.e., the diagnosis of patient illness--which would not be otherwise available to the student and to demonstrate the need for correlating a thorough case history with a clinical examination and laboratory tests. Field test results show that the program meets student needs and saves them time, and that they prefer the CAI mode.

SECTION 3: PLATO AND TICCIT

Anastasio, Ernest J., and Donald L. Alderman. EVALUATION OF THE EDUCATIONAL EFFECTIVENESS OF PLATO AND TICCIT. Princeton, New Jersey:

Educational Testing Service, 1973. 13pp. ED 088 934.

This evaluation of the Programmed Logic for Automatic Teaching Operations (PLATO) and Time-Shared Interactive Computer-Controlled Information Television (System) (TICCIT) programs focuses on their costs, performance, and educational effectiveness. The cost component attempts to assess the economic effects of each of the systems on the participating educational institutions. The technical component monitors the performance of each of the two systems to discover and explain strengths, weaknesses, and implications for further use. The educational component focuses on evalution of the effet of computer-assisted instruction (CAI) upon student performance and behavior; assessment of the impact of the CAI upon instructors, administrators, and the institution itself; and appraisal of the potential and effect of the methods used to produce, operate, and maintain the course materials.

Broderick, William A. INSTRUCTIONAL DEVELOPMENT FOR THE FLORIDA PLATO PROJECT: PROCESS AND EVALUATION. Tallahassee, Florida: Florida State University, Center for Educational Design, 1975. 18pp. Paper presented at the Meeting of the American Educational Research Association, Washington, D.C., March 30-April 3, 1975. ED 107 242.

The design and evaluation of modules of instruction with the PLATO IV Computer System for stimulus display and response recording are described. Steps in the instructional design process are described as problem identification and task analysis, identification of entry characteristics, development of performance objectives, development of evaluation instruments, determination of instructional sequence, design of instructional components, and production of instructional materials. Evaluation is discussed in terms of product evaluation, process evaluation, and system effectiveness.

Sunderson, C. Victor. TEAM PRODUCTION OF LEARNER-CONTROLLED COURSEWARE: A PROGRESS REPORT. Provo, Utah: Brigham Young University, Institute for Computer Uses in Education, 1973. 25pp. Preprint of published proceedings of the International School of Computer in Education (ISCE), Summer, 1972. ED 083 804.

A project developed by the MITRE Corporation and Brigham Young University (BYU) is developing hardware, software, and courseware for the TICCIT (Time-Shared, Interactive, Computer-Controlled Information Television) computer-assisted instructional system. Four instructional teams at BYU are developing courses in remedial algebra, elementary functions, remedial English, and freshman English for junior colleges. Major courseware includes three levels of student-machine communication, a modular approach to courseware structure designed around a taxonomy of instructional variables, and learner-controlled interfaces between the student and the system. The courseware seeks to present the required content to students at a low cost so that they develop content mastery in an effective manner and also acquire improved learning strategies, a positive outlook to learning, and greater responsibility for their own development.

King, William A. A COMPARISON OF THREE COMBINATIONS OF TEXT AND GRAPHICS FOR CONCEPT LEARNING. TECHNICAL REPORT 76-16. San Diego, California: Navy Personnel Research and Development Center, 1975. 23pp. ED 112 936.

Using PLATO, a computer-assisted instructional system, a test was conducted to see if students respond most favorably to an instructional package that included no graphic display, still graphic display, or animated graphic display. Forty-five students at the Naval Training Center, San Diego, were the subjects. With the learning of the sine-ratio concept as the instructional objective, three different instructional packages were written, employed, and posttested. Scores showed that including graphic displays does not improve conceptual comprehension.

Klaff, Vivian, and Paul Handler. COMPUTER ASSISTED INSTRUCTION OF POPULATION DYNAMICS: A NEW APPROACH TO POPULATION EDUCATION. REPORT NO. T-19. Urbana, Illinois: University of Illinois, Coordinated Science Laboratory, 1975. 56pp. ED 113 269.

Available on the University of Illinois PLATO IV Computer system, the Population Dynamic Group computer-aided instruction program is described and explained. The computer-generated visual graphics enable fast and intuitive understanding of the dynamics of population and of the concepts and data of population. The basic program is a population projection model which can forecast the population of over 120 countries, based on either constant or changing 1970 assumptions about demographic parameters. Other programs in the series contribute additional parameters including economic development, educational development, food demand and supply, energy demand, labor force analysis, migration and urbanization, population history, and birth control use. These materials explain how to use the system; provide information on concepts, definitions, and the program algorithms; and provide suggestions for the practical applications of the program.

Lyman, Elisabeth R. A SUMMARY OF PLATO CURRICULUM AND RESEARCH MATERIALS. Urbana, Illinois: University of Illinois, Computer Based Education Laboratory, 1972. 52pp. ED 066 931.

PLATO (Programmed Logic for Automatic Teaching Operations) is a computer-based teaching system which was developed in the Coordinated Science Laboratory at the University of Illinois to explore the possibilities of automation in individual instruction. The history of the PLATO program is summarized here, along with a list of courses which used PLATO during the academic year 1971-72. A summary of PLATO materials used by students in many fields, including accounting, astronomy, medicine, biology, foreign languages, engineering, mathematics, urban planning, and veterinary medicine. A chronological bibliography of all PLATO publications is also provided.

McDougall, William Donald. COMPUTER-ASSISTED EDUCATION SYSTEM FOR PSYCHOPHARMACOLOGY. Doctoral Thesis. Walden University, Naples,

Florida, 1975. 189pp. ED 110 022.

An approach to the use of computer assisted instruction (CAI) for teaching psychopharmacology is presented. Using the TUTOR programing language on the PLATO IV computer system, several computer programs were developed to demonstrate the concepts of aminergic transmitters in the central nervous system. Some of the advantages and disadvantages of TUTOR for such teaching situations are discussed. A flow chart of a computer lesson in this field is provided, and alternative methods of presenting a problem are considered.

Mockovak, William P., and others. THE APPLICATION AND EVALUATION OF PLATO IV IN AF TECHNICAL TRAINING. Lowry AFB, Colorado: Air Force Human Resources Laboratory, Technical Training Division, 1974. 22pp. ED 096 957.

The Air Force has been plagued with the rising cost of technical training and has increasingly turned to computer-assisted instruction (CAI) for better cost effectiveness. Toward this aim trials of PLATO IV, a CAI system utilizing a graphic display and centered at the University of Illinois were initiated. At Chanute training base the trial is based on the development and use of materials for the Special Purpose Vehicle Maintenance Course. One lesson involves use of a battery hydrometer. A secondary program PIRL (PLATO Indicated Reading Level) is being used to determine the reading difficulty of developed materials. At Sheppard training base PLATO IV is being tested on a Physician Assistant program, initially on those aspects of the program dealing with respiratory problems. The PLATO IV program is expected to depart from the old course in its emphasis on a problem-oriented curricula where the trainee repeatedly solves medical problems with the computer as a tutor.

Nievergelt, Jurg, and others. ACSES, AN AUTOMATED COMPUTER SCIENCE EDUCATION SYSTEM. Urbana, Illinois: University of Illinois, Department of Computer Science, 1974. 15pp. ED 097 915.

A project to accommodate the increasing enrollment in introductory computer science courses by automating them with a sybsystem on the PLATO IV Computer-Based Education system at the University of Illinois was started. The subsystem was intended for supplementary instruction, but was also designed to be a completely self-contained system for introductory computer science education at remote sites. The key components of the system are: a library of lessons covering several programing languages, computing techniques, and application areas; a self-contained interactive program system for the preparation, execution, and debugging of programs written by students; a conversation advice-giving and information retrieval system to guide the student through the library of lessons, based on goals and past performance; and a communication system that allows a student to contact a human tutor.

O'Neal, Fred. LEARNER CONTROL OF INSTRUCTION: REQUIREMENTS AND POTENTIALS. Provo, Utah: Brigham Young University, Institute for

Computer Uses in Education, 1973. 17pp. Paper presented at the ADCIS Conference, Ann Arbor, Michigan, August 9, 1973. ED 083 805.

Learner-controlled instruction (LCI) provides a model for developing the self-directed learners modern society requires. LCI allows the student to specify goals, to control significant resources to attain them, and to choose learning strategies. It appears that the environment needed to support this model must rely heavily upon computer-assisted instruction (CAI) and computer-managed instruction (CMI). Time-shared terminals and sophisticated hardware are required, and it is necessary to reorganize content fields for learner-controlled manipulations. Additionally, research needs to identify those who are unlikely to succeed in LCI and to discover how to remedy this problem. The TICCIT system at Brigham Young University is being used to field test an LCI program in which learners control the pace, sequence, and mode of instruction, specify the depth and detail of instructional interaction, and determine access to support facilities and advice. Evaluation after two years will determine the success of the system.

AN OVERVIEW OF THE TICCIT PROGRAM. McLean, Virginia: Mitre Corporation, 1974. 71pp. ED 089 663.

The MITRE Corporation is disseminating computer-assisted instruction (CAI) through a demonstration program funded by the National Science Foundation. The goal is to show that CAI can provide improved, cost-effective instruction in community colleges. Products include: two demonstration systems, each with 128 student terminals; four semesters of math and English courses; and a package of authoring and delivery software. Some innovations of the Time-Shared, Interactive, Computer-Controlled Information Television (TICCIT) system are: (1) courseware designed to produce mastery, improve learning strategies and student attitudes, and develop responsibility; (2) the use of audio and color television displays; (3) minicomputers to power self-contained systems; (4) low system cost of approximately $450,000 for one system or $250,000 for moderate quantities; (5) efficient courseware production procedures; and (6) an on-line authoring system which produces quality CAI.

PLATO ELEMENTARY READING CURRICULUM. Urbana, Illinois: University of Illinois, Computer-Based Education Laboratory, 1974. 471pp. ED 105 377.

The PLATO Elementary Reading Curriculum (PERC), a computer-based instructional program, is presented. The aims of the PERC staff were to: (1) build a complete computer-based reading curriculum designed to bring students from illiteracy to literacy; (2) design into the curriculum the possibility for use in a wide range of modes; (3) take full advantage of the unique audiovisual capabilities of the PLATO IV terminal; and (4) demonstrate the feasibility of PERC in a variety of public school settings. Although the long-range goal is to create a complete curriculum for kindergarten through grade six, only the beginning reading (kindergarten and part of first grade) section is described in

this document.

Schuyler, James A. HYPERTEXT + TUTOR = HYPERTUTOR. Paper presented at the Association for the Development of Computer-Based Instructional Systems Summer Meeting, Portland, Maine, August 4,5, 1975. 17pp. ED 111 398.

The HYPERTUTOR incorporates the ideas of a "hypertext" and the TUTOR-IV programing language used on the PLATO-IV system. The HYPERTUTOR is a part of Northwestern University's MULTI-TUTOR system and allows the transfer of courseware from PLATO to non-PLATO systems. This paper outlines the rationale for the creation of such a system, and gives the background of MULTI-TUTOR, its systems structure, and its compatibility problems with PLATO's Tutor. Current MULTI-TUTOR sites are listed along with an outline of the clearinghouses for lessons now being established at Northwestern. An analysis of current cost factors of the MULTI-TUTOR system is included.

VISUAL SEARCH ACTIVITY: A TOOL FOR THE EVALUATION AND DEVELOPMENT OF COMPUTER-ASSISTED READING INSTRUCTIONAL PROGRAMS. ANNUAL REPORT. St. Louis, Missouri: Washington University, Behavior Research Laboratory, 1975. 17pp. ED 112 362.

Information on six research programs which studied eye movements during reading and evaluated aspects of PLATO-displayed reading instructional material is provided in this report. An analysis of eye movements of "competent" and "less competent" readers reading for general and detailed information showed many differences between them. One of the findings is that competent readers made fewer saccadic eye movements per line of print and spent less time on fixation pauses. In addition, when reading for detail, they did not change the size of the informational chunk taken in during each fixation pause but did increase the amount of time spent on such fixation pauses. Less competent readers decreased the informational chunk taken in per fixation but did not change the amount of time spent per fixation. A study of informational chunking which investigated the effects of the wider angular distance of the PLATO display and typed materials suggests that a drop in efficiency of reading speed is noted when reading these compared to reading a printed book format.

SECTION 4: RESEARCH VIA CAI

Barr, Avron, and others. THE COMPUTER AS A TUTORIAL LABORATORY: THE STANFORD BIP PROJECT. Stanford, California: Stanford University, Institute for Mathematical Studies in Social Science, 1975. Technical Report Number 260. 79pp. ED 114 054.

The BASIC Instructional Program (BIP) is an interactive problem-solving laboratory that offers tutorial assistance to students solving introductory programing problems in the BASIC language. After a brief review of the rationale and origins of the BIP instructional system, the design and implementation of BIP's curriculum information network are described.

Beard, Marian, and others. THE IMPROVEMENT AND INDIVIDUALIZATION OF COMPUTER-ASSISTED INSTRUCTION: FINAL REPORT. Stanford, California: Stanford University, Institute for Mathematical Studies in the Social Sciences, September 1975. 82pp. ED 112 951.

Two methods of teaching foreign language were examined. In the first, the computer stored a profile of the student's previous performance in German vocabulary, and it developed a strategy to teach the student additional German words. The second project tested the effectiveness of a special keyword association method to maximize the retention of Spanish and Russian vocabulary. Two other projects were computer-assisted courses in computer programing: Algebraic Interpretive Dialogue (AID), and BASIC Instructional Program (BIP). In both, the computer combines the student's history and the structure of the curriculum to construct the optimal teaching strategy.

Brown, John S., and others. A MODEL DRIVEN QUESTION-ANSWERING SYSTEM FOR A CAI ENVIRONMENT. FINAL REPORT (JULY 1970 TO MAY 1972). Lowry AFB, Colorado: Air Force Human Resources Laboratory, Technical Training Division; Santa Monica, California: System Development Corporation, 1973. 63pp. ED 077 195.

A question answering system which permits computer-assisted instruction (CAI) students greater initiative in the variety of questions they can ask is described. A CAI system is described which uses an automation model to represent the processes in meteorology. Examples of inferencing techniques using both the automation model and a semantic network are given. A sample session with the system is included in the appendixes.

Brown, John Seely, and others. SOPHIE: A SOPHISTICATED INSTRUCTIONAL ENVIRONMENT. FINAL REPORT FOR PERIOD JANUARY 1974 THROUGH JUNE 1974. Brooks AFB, Texas: Air Force Human Resources Laboratory, 1974. 51pp. ED 107 298.

The SOPHIE program, which implements mixed initiative computer-assisted instruction within a simulated electronics trouble shooting training laboratory interaction, has been extended in several ways. The language processor now accepts nonspecific requsts and resolves these from dialog context. A help requesting facility has been provided whIH will suggest possible faults which could explain the symptoms students have observed. The net effect of modifictions is that a dialog is much more like a conversation with a skilled tutor who can infer what a student means and respond appropriately. The program can be accessed through the ARPA network of computers.

Collins, Allan. PROCESSES IN ACQUIRING KNOWLEDGE. TECHNICAL REPORT NO. 1. Cambridge, Massachusetts: Bolt, Beranek, and Newman, Inc., 1976. 63pp. To appear in R.C. Anderson, R.J. Spiro, and W.E. Montague, eds. SCHOOLING AND THE ACQUISITION OF KNOWLEDGE. Hillsdale, New Jersey: Erlbaum, 1976. ED 116 705.

A theory of Socratic tutoring was developed in the form of

pattern-action rules for a computer program. The rules were derived from analyses of a variety of tutorial dialogs. The 23 rules were designed to formalize causal knowledge and reasoning, and they included such abilities as forming hypotheses, distinguising between necessary and sufficient conditions, making uncertain predictions, determining the reliability and limitations of these predictions, and asking the right question when there is not enough information to make a prediction.

Collins, Allan, and Mario C. Grignetti. INTELLIGENT CAI. FINAL REPORT (1 MARCH 1971-31 AUGUST 1975). Cambridge, Massachusetts: Bolt, Beranek and Newman, Inc., 1975. 56pp. ED 114 089.

Intelligent computer-assisted instruction systems are exemplified by several tutorial systems including Tutor-SCHOLAR, Map-SCHOLAR, NLS-SCHOLAR AND SOPHIE. The original SCHOLAR program structure made it possible to model the way human tutors interact with students. Further analyses of tutoring and teaching strategies led to the development of Tutor-SCHOLAR. Intelligent computer systems illustrate how a variety of techniques can be used for tutoring visual knowledge, procedural knowledge, and diagnostic skills using natural language.

Dansereau, D. R., and others. FACTORS RELATED TO DEVELOPING INSTRUCTIONAL INFORMATION SEQUENCES: PHASE I. FINAL REPORT. Lowry AFB, Colorado: Air Force Human Resources Laboratory, Tehnical Training Division; Forth Worth, Texas: Texas Christian University, 1974. 81pp. ED 089 730.

A two-phased research project sought to develop instructional sequences for computer-assisted technical training materials which would reduce student learning time. In Phase I, technical concepts embedded in training materials were subjected to Inscal Multidimensional Scaling to determine their complexity and relationships. These materials were then revised. Pictorial analogues of verbal materials and tests were developed and the added measures of (1) Cloze Comprehension, (2) Concept Cloze Comprehension, (3) Post-insructional Concept Similarity Ratings were used. Analysis of performance measures indicated that the Inscal technique aided the definition of information complexity of technical material, the development of sequences of concepts, and the creation of an index of inter-rater consensus. Parameter values selected for the Phase II experiment included: (1) determination of presentation rate; (2) selection of performance measures; (3) refinement of presentation and test modes; (4) selection of three instructional sequences; and (5) inclusion of individual difference measures to assess variance in student aptitude.

Feurzeig, Wallace, and others. OPTIMIZING THE EFFICIENCY OF COMPUTER AIDED INSTRUCTION. FINAL REPORT. REPORT NO. 2992. Cambridge, Massachusetts: Bolt, Beranek and Newman, Inc., 1975. 50pp. Available from National Technical Information Service, Springfield, Virginia 22151 (MC-$0.95, HC-$3.00).

To minimize training time, an adaptive training model for optimizing path sequencing in computer-aided instruction was developed. The model reduced a course to logical components or quanta, then plotted the material for possible sequences and evaluated each component quanta as to importance to subject assimilation. For implementation and testing, the model was supplied to a computer programming course offered at Sheppard Air Force Base. Computer programming was the subject selected because conceptual quanta of introductory programing do not have to be rigidly structured; many sequences are possible. The completed course materials were extensively evaluated by programing instructors who estimated that training time had been reduced between 10 and 23 percent. They felt that the principal values of the program were in its improved presentation, reduction of instructor time, better instruction for slow learners, and use as a refresher course.

Fisher, Maurice D., and others. STUDENT CONTROL AND CHOICE: THEIR EFFECT ON STUDENT ENGAGEMENT IN A CAI ARITHMETIC TASK IN A LOW-INCOME SCHOOL. TECHNICAL REPORT NO. 41. Stanford, California: Stanford University, Stanford Center for Research and Development in Teaching, 1974. 71pp. ED 095 829.

A study was made: (1) to determine whether children allowed to choose the difficulty levels of their arithmetic problems in a computer-assisted instruction tasks would show greater engagement in learning than children who were not given a choice, (2) to discover possible patterns in the choices made, and (3) to determine the relationship of locus of control (LOC) attributions to engagement in the task. Among the major findings were: (1) that the choice group was significantly higher in engagement, (2) for both groups, engagement decreased significantly over a 15 day period, and (3) distinctive choice patterns did occur. The findings also showed that children will choose problems that result in poor academic performance; if performance in choice situations is to be improved, training methods that use information about children's unique patterns of choices should be designed.

Fletcher, J. D., and Patrick Suppes. COMPUTER-ASSISTED INSTRUCTION IN MATHEMATICS AND LANGUAGE ARTS FOR THE DEAF. FINAL REPORT. Stanford, California: Stanford University, Institute for Mathematical Studies in the Social Sciences, 1973. 45pp. ED 084 871.

A three-year project supported research, development and evaluation of computer-assisted instruction for hearing impaired or deaf children. Over 4,000 students from 15 schools for the deaf in five states participated in the effort. Although students received CAI in algebra, logic, computer programing, and basic English, the skills subjects of elementary school mathematics and language arts were emphasized. Experimentation ranged from practical evaluation studies of the specific curriculums to general, theoretical studies of the use of language by deaf students. The project demonstrated that CAI can significantly benefit deaf students, that CAI can support serious research in deaf education, and that CAI is economically practicable. A general aim of the project was to initiate large-scale use of CAI in schools for the deaf, and the available evidence indicates that this

objective was successfully achieved.

Friend, Janesine. PROGRAMS STUDENTS WRITE. TECHNICAL REPORT NO. 257. Stanford, California: Stanford University, Institute for Mathematical Studies in the Social Sciences, 1975. 281pp. ED 112 861.

To explore the problem of designing an automated system for instruction in programing, and to study the problem-solving behavior of students, computer programs written by 40 college students as part of a CAI course in Algebraic Interpretive Dialogue were analyzed. The self-contained course consisted of 50 tutorial lessons; the analysis covers programs written as solutions to 25 programing problems, including 747 problems containing 7,063 commands. The distribution of data over problems and over students is discussed, along with problem difficulty and diversity of student solutions.

Hansen, Duncan N., and others. THE ANALYSIS AND DEVELOPMENT OF AN ADAPTIVE INSTRUCTIONAL MODEL(S) FOR INDIVIDUALIZED TECHNICAL TRAINING; PHASE 1. Brooks AFB, Texas: Air Force Human Resources Laboratory, 1973. 114pp. ED 092 174.

Shrinking training budgets pose a serious problem to those confronted with the present and future challenge of providing competent technicians for increasingly technical positions in a modern Air Force. One solution to this problem has been to harness the capabilities of the computer as an instructional training device. To be cost-effective, computer-based instruction must maximize individual student attainment of training objectives, while simultaneously minimizing training time and costs. Adaptive Instructional Models (AIM) can accomplish training with a minimum expenditure of student time and instructional resources.

Kalikow, Daniel N., and Ann M. Rollins. INFORMATION PROCESSING MODELS AND COMPUTER AIDS FOR HUMAN PERFORMANCE. SECOND LANGUAGE LEARNING. Arlington, Virginia: Air Force Office of Scientific Research; Cambridge, Massachusetts: Bolt, Beranek and Newman, Inc., 1973. 58pp. Available from National Technical Information Service, Springfield, Virginia 22151 (No. AD-777-175, HC-$3.75, MF-$1.45).

The tasks is to carry out the final development of a computer-based system for automated instruction of the new speech sounds of second languages, and to field-test this system. This report describes the first evaluation experiment of the Mark II model of the Automated Pronunciation Instructor (API) system. Two matched groups of students of elementary Mandarin Chinese were studied. One group was tested and trained with the API system; the other was simply tested within the same time frame. Despite the severe limits in the breadth of the student sample and in the time available for training, an improvement was generally observed in the Chinese speech of the students exposed to the API system.

Kevin, Richard C., and Paul G. Liberty, Jr. STUDENTS' PERSONALITY, ATTITUDE, AND LEARNING STYLE AS PREDICTORS OF PERFORMANCE IN AN UNDERGRADUATE ORGANIC CHEMISTRY COURSE USING COMPUTER-BASED EDUCATION.

Austin, Texas: University of Texas - Austin, Project C-BE, 1975. 58pp. ED 115 209.

Students enrolled in an organic chemistry course were given a diagnostic inventory according to the SCRAPE model. Information was obtained on 11 motivational personality variables and three attitudinal variables for students in both computer-based instruction and regular instruction sections. In computer-based instruction sections, applied science majors generally tended to have lower course grades, but had more favorable attitudes toward the course and the computer.

Kimball, Ralph B. SELF-OPTIMIZING COMPUTER-ASSISTED TUTORING: THEORY AND PRACTICE. TECHNICAL REPORT NO. 206. Stanford, California: Stanford University, Institute for Mathematical Studies in the Social Sciences, 1973. 141pp. ED 079 980.

Research constructed a computer-assisted instruction tutor which could transmit problem-solving heuristics, choose examples, handle examples from a range of students, and learn superior student heuristics. Using a student subject model and tutorial strategy, an experiment was conducted with 284 problems. Students improved 25% of the solutions and the tutor acquired some novel solutions. The research clarified the definition of a tutor in CAI, established a methodology for problem solving heuristics, defined and supported a model of how student heuristics change after failure, implemented a scheme for tutor improvement, and combined the results of research in symbolic integration and algebraic simplification for use in CAI.

King, Anne Truscott. IMPACT OF COMPUTER-BASED INSTRUCTION ON ATTITUDES OF STUDENTS AND INSTRUCTORS: A REVIEW. FINAL REPORT. Brooks AFB, Texas: Air Force Human Resources Laboratory, 1975. 33pp. ED 112 872.

To determine whether contact with computer-assisted instruction leads to feelings of "depersonalization" and "dehumanization" a review was conducted of investigations to explore attitudes toward various modes of computer-based instruction before, during, and after exposure. It is concluded that computer-based instruction is not a threat to humanization, and that it can provide opportunities for increasing effectiveness and personalization of the instructor-student relationship.

Koffman, Elliot B., and others. AN INTELLIGENT CAI MONITOR AND GENERATIVE TUTOR. INTERIM REPORT. Storrs, Connecticut: University of Connecticut, Department of Electrical Engineering, 1973. 67pp. ED 078 681.

Design techniques for generative computer-assisted instructional systems are described. These systems are capable of generating problems for students and of deriving and monitoring solutions. Problem difficulty, instructional pace, and depth of monitoring are all individually tailored, and parts of the solution algorithms can be used to analyze incorrect student responses and to direct remediation. A generative CAI system which teaches logic design and

machine-language programing is discussed. This system covers material for an introductory electrical engineering course and is intended to supplement regular instruction by providing practice in problem solving. Also described is a companion system for teaching laboratory principles in which students learn to construct combinational or sequential logic circuits using standard integrated circuits. The student's logic circuit is automatically interfaced to the computer for testing and the computer aids in debugging the circuit.

Laudato, Nicholas C., and Richard A. Roman. COMPUTER-ASSISTED INSTRUCTION IN WORD PROBLEMS: DESIGN AND ASSESSMENT. Paper presented at the American Educational Research Association Annual Meeting, Washington, D.C., March 30-April 3, 1975. 38pp. ED 111 441.

A computer-based curricular package was developed to teach elementary school students to solve arithmetic word problems and to teach problem solving skills applicable to situations not involving word problems. An information processing model for solving word problems was used to sequence the problems. Pilot test results with five students suggested that the sequence derived from the model was hierarchical, that students learned from the program, and that they enjoyed the experience.

Martin, Thomas H., and others. A POLICY ASSESSMENT OF PRIORITIES AND FUNCTIONAL NEEDS FOR THE MILITARY COMPUTER-ASSISTED INSTRUCTION TERMINAL. Los Angeles, California: University of Southern California, Annenberg School of Communications; Marina del Rey, California: University of Southern California, Information Sciences Institute, 1975. 108pp. ED 116 672.

A policy study was conducted in four rounds to assess the anticipated payoff of investment by the Advanced Research Projects Office in the development of a new family of terminals for use by the military in computer-assisted instruction. Members of the panel of experts proposed features, rated them, and reacted to the resulting ratings. Of the 24 features, those rated most needed were seen as likely to be in commercial production five to ten years from now in a form usable by the military. Expert generally agreed that investments in innovative pedagogical software and in innovative course writing are likely to have greater payoff than an investment in terminal development. Of 14 software features, those rated as most needed were ones for particularizing instruction on-line to the course-related needs of individual students. The report is a thorough description of the conduct of the study.

McMullen, David W. COMPUTER-ASSISTED VOCABULARY ACQUISITION: A TERMINOLOGICAL APPROACH. Stony Brook, New York: State University of New York, 1973. 41pp. ED 082 135.

A terminological approach, constructed around key words in textual material, emphasizes vocabulary in the context of organized frames of reference. This research was directed toward stating a terminological approach in operational terms in order to develop and test procedures for acquiring

vocabulary by computer. Three phases are described: (1) the construction of a computer program for comparing two acquisition models, (2) the development of a data base (course content) through the use of the above procedures, and (3) the evaluation of the approach and acquisition models in an experimental study. A blocked-presentation model was compared with spaced presentation. Results favoring spaced presentation are discussed in terms of information encoding, and performance gains are described along with suggestions for improving effectiveness.

Roman, Richard Allan. TEACHING PROBLEM SOLVING AND MATHEMATICS BY COMPUTER: AN INTERIM REPORT. Pittsburgh, Pennsylvania: University of Pittsburgh, Learning Research and Development Center, 1974. 69pp. ED 101 690.

An interim report from the National Science Foundation describes the FUNCTIONS program--an on-going effort to teach problem solving and mathematics by computer. Two problems are discussed: How can math content be taught in a manner which also develops problem solving skills? Also, how does a curriculum organized to develop problem solving skills teach math content? The report concludes that both can be taught if math content is structured as a sequence of problems in which students induce organizational rules from examples. The report includes a description of the procedure, the computer programs, and the preparation of math content. According to this report, 88 percent of students taught this way achieve course objectives.

Seidel, Robert J., and others. LEARNER CONTROL OF INSTRUCTIONAL SEQUENCING WITHIN AN ADAPTIVE TUTORIAL CAI ENVIRONMENT. TECHNICAL REPORT 75-7. Alexandria, Virginia: Human Resources Research Organization, 1975. 54pp. ED 111 338.

A study to test the effects of learner control of the sequencing of instructional tasks when using computer-assisted instruction (CAI) systems is described. Using a series of CAI modules to teach the COBOL programing language to military personnel, students were able to control various aspects of their learning environment. Among the research findings were the following: the instructional module was effective in teaching the students to program in COBOL; aptitude treatment interaction studies can be performed in instructionally rich settings; the set of criteria used to characterized high and low performers needs to be diverse and analytical; and self-assessment can make a significant contribution to instructional management.

Suppes, Patrick. RESEARCH ON USES OF AUDIO AND NATURAL-LANGUAGE PROCESSING IN COMPUTER-ASSISTED INSTRUCTION. ANNUAL TECHNICAL REPORT JULY 1, 1974-JUNE 30, 1975. Stanford, California: Stanford University, Institute for Mathematical Studies in the Social Sciences, 1975. 13pp. ED 115 312.

This annual report of progress of the Institute for Mathematical Studies covers four main projects: (1) computer generated speech, (2) complex teaching programs with audio,

(3) teaching reading with audio, and (4) speech recognition. Thirty-seven references to research on the use of computers and the teaching of primary reading are included. A listing of 15 technical reports issued by the institute during the reporting term is appended.

Taylor, Susan S. THE EFFECTS OF MASTERY, ADAPTIVE MASTERY, AND NON-MASTERY MODELS ON THE LEARNING OF A MATHEMATICAL TASK. Paper presented at the annual meeting of the American Educational Resources Association, Washington, D.C., March 30-April 3, 1975. 48pp. ED 106 145.

Three learning models (adaptive mastery, typical mastery, and traditional non-mastery learning models) which employed different criteria for terminating computer-based practice in order to determine mastery or non-mastery of arithmetic skills were compared. The efficiency of two different sequencing arrangements (mixed and clustered) of practice items also was examined. All treatments involved the teaching of basic arithmetic skills to seventh-grade students. The adaptive mastery learning model produced the same high level of performance on both the posttest and a delayed retention test as the other two models, but required less time, fewer practice items, and minimized overpractice. No significant differences were found between the clustered and mixed item arrangements.

Tennyson, Robert D. ADAPTIVE INSTRUCTIONAL MODEL FOR CONCEPT ACQUISITION. Tallahassee, Florida: Florida State University, Computer-Assisted Instruction Center, 1973. 29pp. ED 073 707.

An adaptive instructional strategy for individualized concept teaching was developed according to decision processes that adjust instructional variables to individual differences and differential performance, either before a task in response to an individual's traits or during a task. An adaptive instructional strategy is presented for teaching concepts according to a learner's error response pattern after an intermediate evaluation with the instructional sequence.

SECTION 5

APPLICATIONS IN TEACHER TRAINING

Carlson, Marthena, and others. A COMPUTER-ASSISTED INSTRUCTIONAL SYSTEM FOR ELEMENTARY MATHEMATICS. Pittsburgh, Pennsylvania: University of Pittsburgh, Learning Research and Development Center, 1974. 85pp. ED 104 667.

The major objective of the Oakleaf Small Computer Project was to individualize elementary mathematics instruction by using a fully-integrated system of computer-assisted instruction, evaluation, and class management. The curriculum was based on IPI Mathematics. The five reports given here provide detailed accounts of the operation of the system, student access to the machine, generation and scoring of tests, recordkeeping

functions. A study of the effects of practice at a computer terminal on the acquisition and retention of computational algorithms is reported.

Cartwright, G. Phillip, and Carol A. Cartwright. TRAINING EARLY CHILDHOOD EDUCATORS: COMPUTER ASSISTED INSTRUCTION COURSES IN DIAGNOSTIC TEACHING. FINAL REPORT (Report No. R61). University Park, Pennsylvania: The Pennsylvania State University, Computer Assisted Instruction Laboratory, January 1974. ED 089 795.

The Computer Assisted Remedial Education (CARE) project developed two computer-assisted instructional courses to train educational personnel in the use of diagnostic teaching with preschool and primary grade children who exhibit learning problems. New technology was used to provide inservice education for professionals who found it difficult to visit training centers for special instruction. The course was successfully delivered by mobile CAI laboratories to sites in Indiana, Georgia, Texas, Illinois, and Washington, D.C., and was used in several universities.

Hall, Keith A. CARE: COMPUTER ASSISTED RENEWAL EDUCATION. University Park, Pennsylvania: Pennsylvania State University, Computer-Assisted Instruction Laboratory, 1974. Paper presented at the Shared Educational Computer Systems (SECOS) Conference, New Paltz, New York, May 1974. 14pp. ED 097 903.

CARE (Compter Assisted Reneval Education) is a mobile computer-assisted instruction program designed to train educators and inservice teachers in the education and handling of handicapped children. The program, developed by Pennsylvania State University and offering college credit, is carried in an expandable trailer with 16 individual student terminals. The CARE curriculum offers four basic courses: early identification of handicapped children, diagnostic and prescriptive teaching of preschool and primary children (two courses), and education of visually handicapped children. Two additional courses are planned for the CARE program and their development will follow the step-by-step course development procedures previously established. The results of an evaluation of CARE indicated that CAI students scored significantly higher in achievement, needed less instruction time, and appreciated the program.

Johnson, Geraldine W. DON'T PROGRAM YOUR WORLD--PLAN* IT. Paper presented at the Annual Meeting of the Plains Regional Conference of the International Reading Association, St. Louis, February 20-22, 1975. 8pp. ED 108 118.

PLAN is a computer-managed individualized learning program with two major goals: to provide each child with an individualized program of studies in the language arts, mathematics, science, and social studies, and to involve students in making decisions and assuming responsibility for their own learning. A computer assists the teacher by scoring and analyzing tests, recording student progress, and providing daily objectives for learning. Teachers spend most of their time tutoring and counseling students on a one-to-one basis or

in small groups, during which time Teaching Learning Units (TLU's) are introduced. A TLU states the objective the child will work toward, lists the materials he or she will use, and prescribes the activities he or she will perform.

Lunetta, Vincent N. COMPUTER IN THE CLASSROOM; A COMPUTER-BASED UNIT IN TEACHER EDUCATION. TECHNICAL REPORT NO. 5. Iowa City, Iowa: University of Iowa, Science Education Center, 1975. 91pp. ED 105 878.

The potential use of computers to enhance individualized instruction is too often neglected in preservice and inservice teacher education. This report describes some materials to introduce teachers to computer applications in support of classroom teaching, including some interactive computer-based modules used at the University of Iowa. Provided are descriptions and information on: (1) staff requirements for implementation, (2) computer modules, (3) a sample unit outline and bibliography for the system, (4) sample program runs for selected topics included in the computer-based teaching system, and (5) the computer program listings for the system--written in BASIC for Hewlett Packard 2000F computers with the Interactive Dialog Facility (IDF). A paper on computer use in teaching at the elementary and secondary level that may be used for both preservice and inservice training is also provided.

McGinley, Pamela R. E. THE TRAINING OF TEACHERS IN THE USE OF COMPUTERS IN THE CLASSROOM. Paper presented at the Association for Educational Data Systems Convention, New Orleans, Louisiana, April 16-19, 1973. 5pp. ED 087 431.

A series of three courses developed by the Northwest Regional Educational Laboratory is illustrative of materials designed to meet the needs of teachers and administrators for pre- and inservice computer science education. These courses can employ experienced outside consultants, stress use of conversational language, and provide hands-on experience with the computer. They were created by the Laboratory's Relevant Educational Applications for Computer Technology (REACT) Program. The first course is aimed at teachers and administrators and covers basic computer concepts and uses, along with their social impact. The second unit is for teachers and deals primarily with the instructional functions of computers, while the final course is intended for administrators and examines a variety of fundamental administrative data processing applications.

Sitko, Merrill C., and others. THE EFFECTIVENESS OF A COMPUTER-ASSISTED TEACHER TRAINING SYSTEM (CATTS) IN GENERATING SPECIFIC TEACHER BEHAVIORS IN A PRESERVICE COLLEGE TEACHING ENVIRONMENT. Paper presented at the Conference on Research and Technology in College Training, Atlanta, Georgia, November 1974. 23pp. ED 111 346.

A prototype computer-assisted teaching training system (CATTS) was developed to help train special education personnel. CATTS is a comprehensive system which produces systematic observation, real-time analysis, storage, and feedback of specific observation coding data relevant to special education

classroom teacher-pupil interactions. An investigation demonstrated the relative effectiveness of CATTS instantaneous (visual) and delayed (printout) feedback in increasing various cognitive and management behaviors of preservice teacher-trainees in a controlled classroom setting. It was found that CATTS is a versatile and comprehensive delivery system which can be applied in many ways to analyze real-time process variables within behavior training fields.

Swigger, Kathleen M. AUTOMATED INSTRUCTION OF FLANDERS INTERACTION ANALYSIS. Iowa City, Iowa: University of Iowa, College of Education, 1975. Paper presented at the Conference on Computers in the Undergraduate Curricula, Fort Worth, Texas, June 16:18, 1975. 12pp. Available from Entire Proceddings, Tad Sjoerdsma, Treasurer, CCUC, 1248 Lindquist Center for Measurement, Iowa City, Iowa 52242 ($10.00; Checks payable to the University of Iowa). ED 111 357.

Computer-assisted instruction lessons were written for students enrolled in a methods course in social studies education at the University of Iowa. Lessons provide instruction in the Flanders Interaction Analysis method which makes classroom verbal communication more effective. An interation module was designed to help prospective teachers examine their own classroom behavior in terms of factors such as how much they talk versus student participation in discussion. Both authoritative and permissive behavior were explored. An experiment compared the CAI method with traditional instruction. The results indicated that the CAI module proved to be the most effective.

DEVELOPMENT OF AUTHOR LANGUAGES

Countermine, Terry A. THE DEVELOPMENT AND EVALUATION OF A TEACHING AND COURSEWRITING COMPUTER LANGUAGE (TACL). Doctoral Dissertation. Pennsylvania State University, University Park, Pennsylvania, 1973. 125pp. ED 089 794.

A description is provided of the design and development of an author language for computer-assisted instruction. This Teaching and Coursewriting Language (TACL) is described as being easy to learn for newcomers to computers and as providing efficiency and time savings in course development without sacrificing power or flexibility. Individual chapters of the report discuss: (1) general aspects of CAI; (2) programing languages for CAI course design; (3) the computer science aspects of CAI author languages; and (4) the implications of TACL.

Hole, Cheryl, and others. CAISYS-8 -- A CAI LANGUAGE DEVELOPED FOR A MINICOMPUTER. Galveston, Texas: University of Texas, Medical Branch, 1973. 26pp. ED 077 252.

The University of Texas Medical Branch developed a minicomputer based computer-assisted instruction system which employed a teacher-oriented software package called CAISYS-8, consisting of a highly modularized teaching compiler and operating system. CAISYS-8 used instructional quanta which

generalized the flow of information to and from the student and encouraged feedback between student and teacher. Individual accumulator registers recorded student responses and directed program branching, and teachers were provided with a completely dichotomous tree structure. The system was found to be useful because the minicomputer itself was less expensive than larger computers and less prone to obsolesence and because the compiler teaching language was readily accepted by teachers.

Kheriaty, Larry. REPORT ON A MINI-COMPUTER BASED INTERACTIVE COMPUTING SYSTEM. Bellingham, Washington: Western Washington State College, 1974. 6pp. ED 093 377.

In spite of the limitations of minicomputers, Western Washington State College (WWSC) has developed a useful interactive computing system based on a Model 7/32 Interdata minicomputer and the computer program, PILOT. The major disadvantages of minicomputers are the difficulty of securing maintenance and the frequent reliance on the single language, BASIC, which is ill-suited fo course-authoring for computer-assisted instruction (CAI). Cost, of course, is the principle advantage. The system at WWSC relies on a multilingual interpreter to execute programs in a constant pattern for all languages, once translated into an internal code of single byte operands and operators. PILOT has structural simplicity and versatility. Perhaps its best feature is its ability to call an already compiled BASIC subroutine. A program was written which can translate COURSEWRITER III to PILOT. The experience of WWSC indicates that a CAI system can be satisfactorily run on a minicomputer if there is access to good software.

Kimberlin, D. A. A PRELIMINARY INSTRUCTIONAL MODEL FOR A COMPUTERIZED TRAINING SYSTEM. Fort Monmouth, New Jersey: Army Signal Center and School, Computerized Training System, 1973. 31pp. ED 083 822.

A preliminary instructional model suitable for lesson preparation for a Computerized Training System is described. Topics include general course architecture, general course structure, and the training decision process. Guidelines for the design of the model are presented and information is provided on the adaptation of the model to three levels of student performance, thus allowing for a learning environment sensitive to individual differences. Flow charts are given to depict graphically the learning contingencies and instructional strategies addressed in the design of the model.

Mudge, J. C. HUMAN FACTORS IN THE DESIGN OF A COMPUTER-ASSISTED INSTRUCTION SYSTEM. TECHNICAL PROGRESS REPORT. Thesis submitted to the Department of Computer Science. University of North Carolina, Chapel Hill, North Carolina, 1973. 324pp. ED 082 487.

A research project built an author-controlled computer-assisted instruction system to study ease-of-use factors in student-system, author-system, and programer-sysem interfaces. Development of course material by authors, use by students, and administrative tasks were integrated into one

system whose nucleus was a display-based interactive author language (DIAL). The design permitted systematic language implementation and easy language modification and used a translator writing system (TWS) to generate compilers. Authoring by teachers required simplicity of the language and its operational environment. A measured high level of user acceptance proved the design to be sound. DIAL was observed to be a superior language, for machine intrusion was low and other syntactic improvements were possible. An answer-evaluating technique, called the sieve, was devised and a syntactically improved DIAL/2 language derived. The TWS helped to implement DIAL and to remediate language weaknesses.

A REPORT ON PLANIT: ONE STAGE OF COMPLETION. FINAL REPORT. Portland, Oregon: Northwest Regional Educational Laboratory, 1975. 101pp. ED 112 917.

The narrative portion of this report describes the results of a recent survey of the users of PLANIT, a computer language designed to make computer-assisted instruction easier and more accessible to the user who is inexperienced with computers. The survey shows that with recent revisions in the system, user satisfaction has increased, but areas of user discontent still exist. Methods are suggested to make the system more effective. Included in the appendix of this document are a description of the PLANIT system, a discussion of its potential uses in the field of instruction, and an information brochure regarding its availability.

DISTRICT-WIDE EXPERIENCE

Chapin, John D., and others. AN INTERACTIVE MANAGEMENT INFORMATION SYSTEM FOR THE SUPPORT OF INDIVIDUALIZED INSTRUCTION: A LESSON ON HOW TO MANAGE COMPUTER MANAGED INSTRUCTION. Paper presented at the Annual Meeting of the American Educational Research Association, Washington, D.C., March 31-April 3, 1975. 70pp. ED 104 000.

Computer-managed instruction should be able to meet student needs immediately, remove clerical tasks from teachers, process information at student-pace demand, and fit the prescribed curriculum. To create such an integrated program of compatible instruction, curriculum, and information system, a Madison, Wisconsin, Public Schools Title III project has concentrated on developing management structures in curriculum, instructional sequence, space allocation, task allocation, material acquisition, materials distribution, and information structure. The overlapping of these areas creates, within the constraints of time, money, and space, the ability to individualize student learning.

Dunn, Alex, and others, eds. COMPUTER-ASSISTED INSTRUCTION PROGRAM. A THREE-YEAR REPORT COVERING JULY 1, 1971 THROUGH JUNE 30, 1974. Rockville, Maryland: Montgomery County Public Schools, 1974. 203pp. ED 100 361.

The Montgomery County Public Schools Computer Assisted Instruction Program began in 1968, was federally funded for

its first three years, and since 1971 its activities have been supported through local funds and an outside grant covering the lease of the computer. During the last three years validated CAI materials developed during the first phase of the project were placed in classrooms, and evaluation studies were undertaken. CAI capabilities were extended to a junior high school and to a first grade classroom at one elementary school. The instructional objectives and CAI applications for each grade level and subject area are described in this report, as are the evaluation findings and suggestions for further research and development. Some comments on possible future directions for CAI in public schools are also included.

Peckham, Herbert D. COMPUTING IN THE COMMUNITY COLLEGES--FACT AND FANCY. Gilroy, California: Gavilan College, 1973. Paper presented at the Association for Computing Machinery Conference, Atlanta, Georgia, August 1973. 8pp. ED 084 828.

The best way to introduce computers into the instructional program of the small community college is to start with an inexpensive interactive system devoted primarily to campus instructional needs and financed by the college itself. This runs counter to the predominant idea that the optimum procedure is to begin with remote terminals connected to a large computer located elsewhere and to limit the initial effort to batch processing, but there is good evidence available to support violating the conventional wisdom. Analysis of data indicates that, contrary to general belief: (1) it is cheaper to operate a small on-site system than to pay for remote computing services; (2) the overhead and operating costs for a small system are not beyond the means of a small college; (3) cost is not the chief obstacle to the implementation of computer-assisted instruction; (4) government projects offer little help to the community college; (5) interactive capabilities are essential; and (6) CAI research and innovation can be done at the community college level, where resistance to change is often less than at the large universities.

Perry, Robert P. LRC COMPUTER NETWORK. Princeton, West Virginia: Mercer County Board of Education, 1973. 9pp. ED 084 822.

A consortium of small rural school districts in West Virginia was created to sponsor a regional educational computer network. The project sought to provide computer science education for selected students, to complement science and mathematics instruction through computer-assisted instructional problem-solving activities, and to aid administrative services. Seventy-five teachers received training and participated along with 2000 secondary students. In general, it was found that the computer performed calculations well, relieved students of tedious tasks, aided evaluations, promoted problem-solving and discovery learning, improved instruction and motivated students and teachers. All of the 647 students who took the computer science course passed at least 80% of the performance objectives and 90% of them used their skills afterwards. In the math and science courses, pre- and post-tests of selected units revealed an improvement of 40% in student performance after five hours of

CAI instruction. Low ability students using CAI showed marked gains in both reading and math, and administrative tasks were successfully handled by the computer. Thus, it was concluded that consortia of small districts could justify the expense of a computer network.

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The material in this publication was prepared pursuant to a contract with the National Institute of Education, United States Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their judgement in professional and technical matters. Prior to publication, this manuscript was submitted to a faculty member of the CAI Laboratory at The Pennsylvania State University for critical review and determination of professional competence. This publication has met such standards. Points of view or opinions, however, do not necessarily represent the official view or opinions of either the reviewer or the National Institute of Education.
Contract No. NIE-C-74-0027.